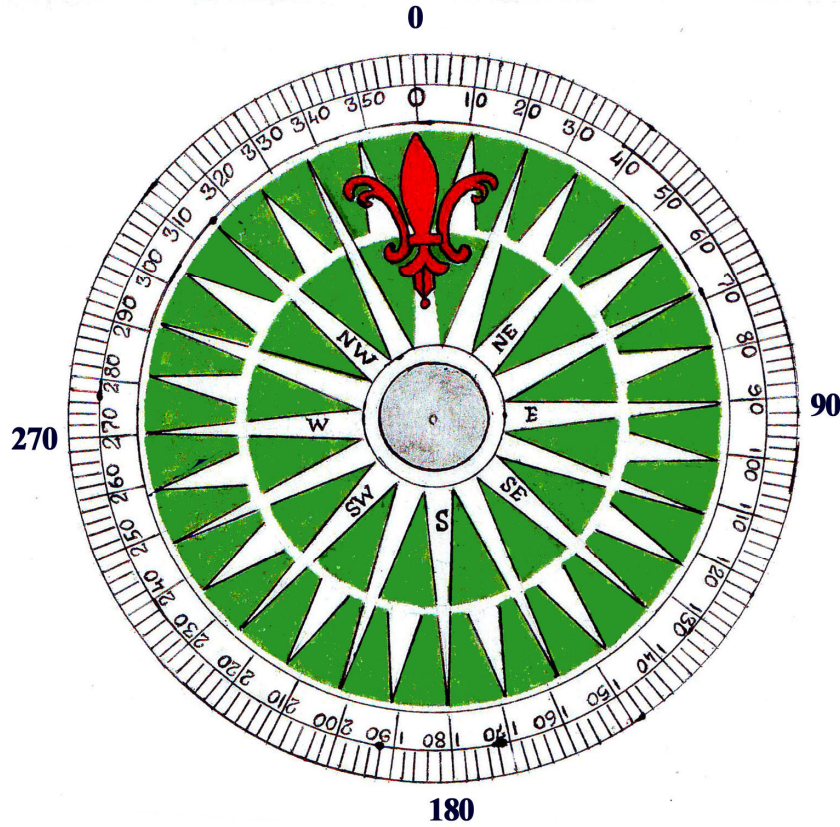


Magnetic Compass and Its Declination from Standard Directions



Quazy Abdulla Muhammed Chembarikka

Important works of author

- 1 Fathahul Kanz (A verse in Arabic Malayalam)
- 2 Tazveedul fikari val himam fee tabyeenil nisabi val Logarithm
- 3 Ilmul falak ala lauil ilmil hadees
- 4 Istikhraj aukathi ssalathi vasumoothil Quibla ala hisabi Logarithm
- 5 Al boosilathul Mignateesiyya vanhira'fa anil jihathil asliyya
- 6 Adabul siyami va favaiduha
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- 8 Magnetic Compass and its declination from standard directions

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Magnetic Compass and Its Declination from Standard Directions

Foreword

Most of the people do not care to check the Magnetic Compass they use for making out various points of the basement of their structures for Homes or Mosques where accurate directions of cardinal points should be known. They do not consider the value of the magnetic variation of the place at all while using a magnetic Compass. This aspect was the inducement for the author for endeavor.

I have tried, in very simple term in the following pages a brief history of magnetic Compass and clear description of declination of the magnetic needle from the true direction including the method by which to find out the standard direction (cardinal points). This book not only explains the direction and the declination but also guides you to achieve them from their sources.

I am very thankful to those prominent persons who helped me in this handy-work. First of all I thank Anver hudavi, the former principal in charge of M.I.C. Darul Irshad Academy, Chattanchal, Kasargod, who co-operated with me in making this version and Ismail hudavi, who was in close co-operation with me in all works. and Dr.Abdul Azeez , M.A, PhD, the principal of M.I.C Arts and Science College, Chattanchal, Kasargod, who conducted a detailed look-over in matters of literature and Ahmad Kalanad (BE) superintending Engineer (retd.) who gave me most valuable information and instruments.

Quazy Abdulla Muhammed Chembarikka

The term direction is generally understood to every one but it is difficult to one to define it because all directions are related to another direction. Therefore it is necessary for practical purpose, Eg: navigation or Quibla determination that there should be some selected fixed directions to which other directions could be related Eg: Quibla point from Kasargod is 19°45' North from West or 289° 45' from North.

The fixed directions are called standard directions. This is provided by the familiar and universally adapted system of North, South, East and West and their sub divisional points.

North Direction

The North direction is fixed by the position of the North pole Which is an imaginary point at the one end of Earth to the Zenith of Which the pole star is very close. The South is the opposite direction from the North. East and West directions are at right angles to these.

Magnetic Compass or Mariner's Compass is a most useful instrument to determine the directions.

This instrument has a magnetized needle which is free to move in a horizontal plain. The needle always shows not towards the true North but towards the direction which is called the magnetic North. The amount of angle of declination from the true North could be found at various places on the earth and with its correction the true North can correctly be found. The details of that will come afterwards.

Divisions of the Compass

Thirty two divisions system

It is mentioned that the main part of compass is a magnetic needle. The second part is the Compass card or dial. In the dial two diameters at right angle to one another divide the circle into four quadrants representing North, South, East and

West. Each of the Quadrants is further subdivided into eight equal divisions. Thus the whole circle has thirty two divisions each of which represent a definite direction. The names given in the figure to indicate these directions are shown for the first quadrant only (fig 1).

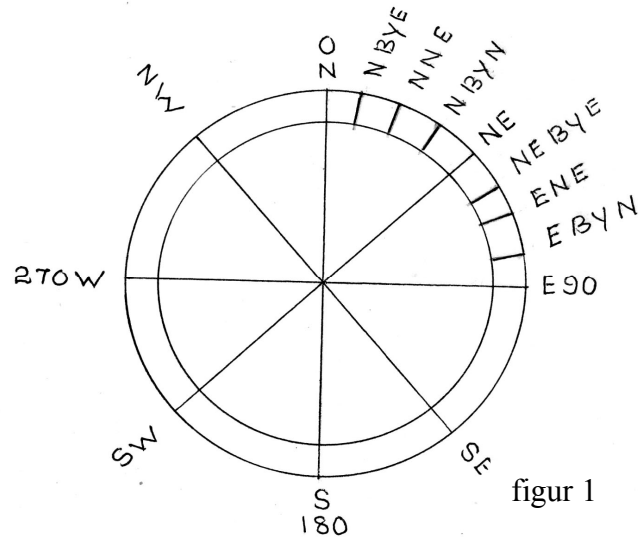


figure 1

Those in other quadrants are similarly divided and described. The arc of each of the thirty two divisions substance an angle which must be 11.25° because the whole circle is 360° ($360/32=11.25$)

Quadrant system

This system is still widely used because it is very useful for the working of many navigation problems. It is also useful for the working of Qibla notation using quadrant (Al-Rubah-Almujeyyeb) which is marked from 0° to 90° . In this system the compass is divided in to four quadrants by the cardinal points. N, E, S and W. directions are given to the East of North up to 90° . To the East of South up to 90° . To the West of South up to 90° . And to the West of North up to 90° (see fig 2).

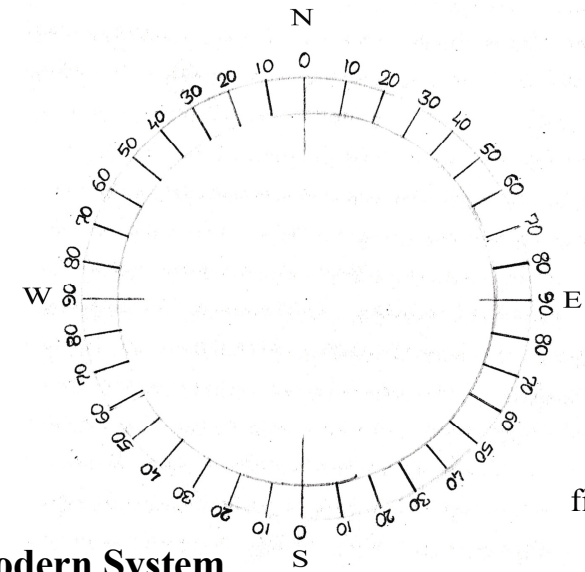


figure 2

The Modern System

There is another system which is modern and most efficient method for indicating directions. In this system north is 0° or 360° , east is 90° , south is 180° and west is 270° . Thus in this system the compass is marked in succession from 0° to 360° in a clock wise direction. This method is most useful to determine Qibla points in which directions of Qibla display automatically (see fig 3).

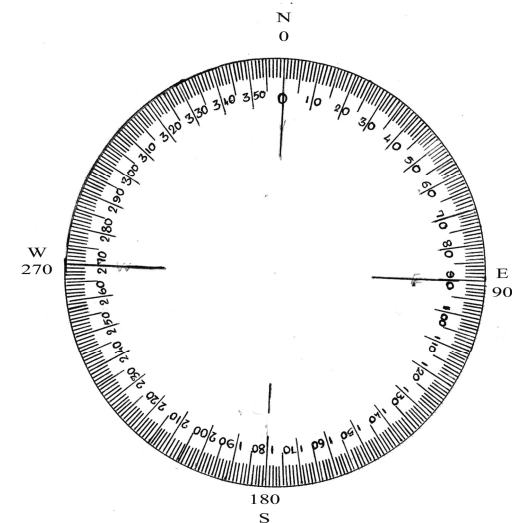


figure 3

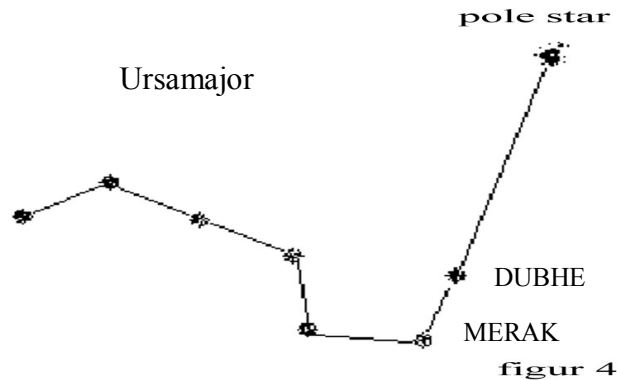
Specification of directions

It is supposed that the first identified direction is north. Because a star is twinkling at the zenith point at one of the two poles of Earth though it is not a bright one and that pole is named as North. Then the opposite is south. The East and West are at opposite sides in right angle.

Finding of the pole star

Pole star has significant status in the field of navigation and among desert travellers since very early times because it is the only star standing in certain celestial point with out moving neither to West nor to East. It is very near to the celestial North Pole and on the zenith of the North Pole of Earth. For this reason it has earned this position though it is not belonging to the bright stars in the sky.

You can find out the pole star with the help of the constellation Ursamajor and two guide stars Dubhe and Merak (see fig 4)



Finding out the directions by pole star

It was custom both in old times and nowadays to find out the direction by observing the pole star. This was done by setting illumination with a candle or a small electric bulb on a high stand.

Koyithatta the Malayalee astrologist said in his book Sugavasa Bhavanangal (Homes for resting)

ഉയരദ്രീപമെരിയിച്ചു- ഞരധുവരേഖയിൽ
തട്ടിച്ചുനോക്കിയാലാരാൽ -കാണുമുത്തരദിക് സ്ഥിതി.

“You can find out the North direction by illuminating a lamp on a higher place and observing the portion”

When we got the North point we can easily find the South point also because it is the opposite point in the line. Draw a line at right angle to the North south line. It will represent the East West directions. It is obvious that this system became useless in the Southern Hemi sphere.

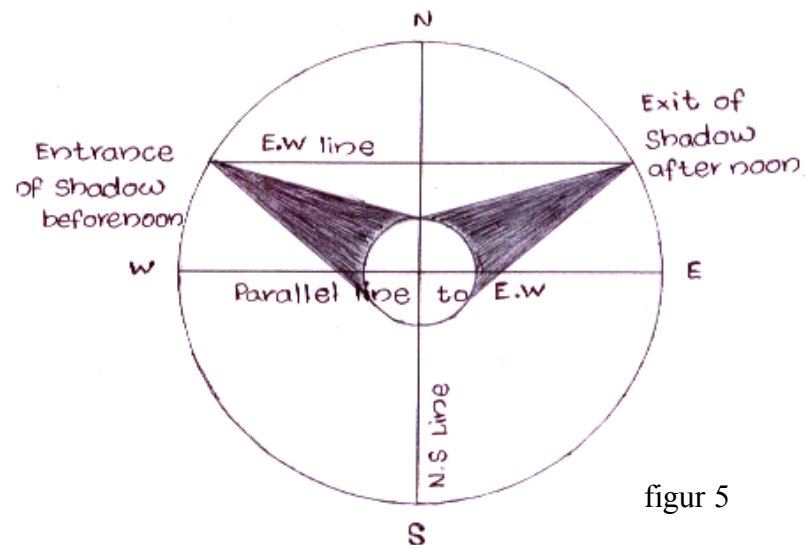
Finding Direction by Sun Shadow.

Koyitatta writes in the Book ‘Homes for resting’ as follows;

ശങ്കു ദീർഘമിരട്ടിച്ച
വൃത്താർദ്ധം കൊണ്ട് സൂക്ഷമമായ്
വരക്കവൃത്തം നടുവിൽ
നിൽക്കും കുറ്റിക്കുചുറ്റുമായ്
വൃത്ത രേഖയിൽ വീഴുന്ന
ശങ്കുചരായകുറിക്കണം
പടിഞ്ഞാറുചുതൻമുമ്പ്
കിഴക്കുചുയ്ക്കു ശേഷവും
കുറി രണ്ടും തൊട്ടുനീളെ
വരക്കും ജ്ജുരേഖയാൽ
നേർകിഴക്കുപടിഞ്ഞാറാം
ദിക് സുത്രമുളവായിടും.

Sheik Thahir Jalaluddeen Malesia said in his famous book ‘Nukbathu -ul- Thakreerath’ There is an easy way to fix midday time by illustrating a circle which is Called in Arabic ‘Dairathul Hindiyya’ (Geometrical Circle). Make the surface of a plane leveled using any of the Earth leveling instrument . Draw a circle, set a Conic Stick on the centre of circle the radius of the circle should be equal to the said Conic Stick then mark the entering point of shadow of the stick in Western side before noon and mark the exiting point in the Eastern side after noon and join the two points with a straight line which will represent the East West directions. Draw another line at right angle

crossing the former which will be North South line and on the plane of your meridian. It is better to do this practice on about 21st March or 23 September (see figure 5)



figur 5

Finding direction by Magnetic Compass

This is widely used nowadays for determining directions especially the direction of Quibla for Muslim mosques. But many people do not check the Compass to define the declination of the needle from true directions supposing that Magnetic Compass in hand is true North showing instrument. They do not think about the variations. This makes mistakes in fixing basement point for mosques.

First Magnetic Compass.

The old magnetic Compass to be used Consisted of a long sliver magnetized suspended by a thin cord tied round its middle. It is found (1) that this piece of stone always aligned itself approximately the direction north and South. It was also found (2) that it did not always lie on horizontal plain. If one travelled far enough North, the North end began to dip down and

if one travelled far enough South then the South end began to dip down. Also it was found (3) that the North end of the piece of stone only pointed approximately north. You can observe by comparison with the well known polestar or by the sun shadow circle system (الدائرة الهندية) that the North end of the needle pointed to the East of North in some localities and to the West of North in others (see the Book Navigation by A.C. Gardner)

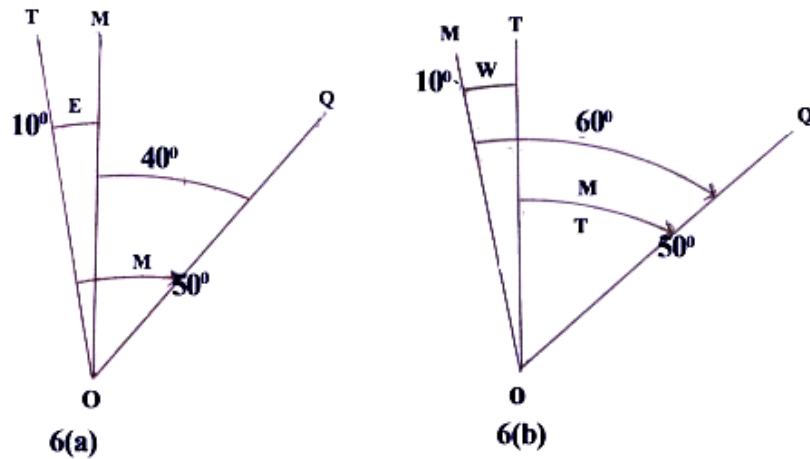
In modern Magnetic Compass the needle is made of hard steel and it is artificially magnetized by electricity and which is constrained by mechanical means to always lie in the horizontal plane and is not permitted to dip down wards. At the same time the declination of the needle to the East of true North in some localities and to the West of North in others is still existing. There is another type of compass which indicates directions relative to the true meridian (or the true North and South) which is called 'Guyro' compass. But it is very complicated instrument and it has been known to break down at the most inconvenient times. So the every time useful one is the ordinary magnetic compass. But it is dispensable that we must have to aware of its declination to east or west of the true North.

The mode of declination of the magnetic needle

If we take a magnetic compass on shore and made sure that there is no iron or other magnetic material any where near it or any thing effecting the magnetic needle then the Compass needle will lie in magnetic meridian (and not in Geographical meridian) The same will happen if we take a compass out to sea in an entirely wooden boat that has nothing magnetic in structure or equipment.

The angle between the magnetic meridian and the true meridian at any place is called the magnetic variation or briefly the "Variation" (الانحراف). If the magnetic meridian is to the left (West) of the true meridian then the variation is West (minus). If to the right (East) it is (plus). The minus variation is to be added to the true meridian and the plus variation is to be subtracted

from the true meridian to get the magnetic direction .E.g. The Quibla point from a certain place on Earth.



In figure 6(a) suppose OQ is a direction to Quibla in a place which is 50° from the true meridian and 40° from the magnetic meridian, the variation is 10° E. This variation is to the right of (+) the true direction or true North. Then it would be subtracted from the true direction (50°) to get the magnetic direction of Quibla from that place (40°).

Figure 6(b) OQ = direction to Quibla in a place which is again 50° from true meridian. But it is 60° from the magnetic meridian. the variation being 10° W (-) from true meridian of True North. Then we added 10° to the true meridian or true North to gain the Quibla point 60° from the magnetic meridian or magnetic North. There is derived a rule as follows ;

Variation West Magnetic Best

Variation East magnetic Least .

That is variation West(-) to be added and variation East (+) to be subtracted.

Why this variation?

You know that the needle of the compass is a magnetized steel and all magnetical materials attract the other magneticals . The Earth itself is a huge magnet having a magnetic field surrounding the surface of it . So every magnetical thing under the field will be attracted by the Earth obeying the wellknown magnetical laws .For this reason the magnetic needle lies on the North-South line .But not on the Geographical meridian but on the line of magnetic North and South poles . The magnetic poles differ from the Geographical poles . The difference is not fixed because the North magnetic pole is moving slowly all the time . It makes a circle round the North geographical pole in about one thousand years.

It is said that the North magnetic pole continues to shift and is located at present (2007 AD) approximately at latitude 82° N and Long 114° W. And the South magnetic pole also shifting and it is now located at about 66° Lat S, and Long 139° E (See Latest Almanacs)

Definition of the Magnetic Meridian

It is known that the Earth is a huge magnet and it has a magnetic field around its surface and the magnetic materials under this field are attracted by the magnetic forces surrounding the Earth. Magnetic meridians are not parallel to the Geographical meridian and also the lines of force do not flow in a constant direction from South magnetic pole to North magnetic pole . Thier direction fluctuates considerably, and for this reason we cannot define the magnetic meridian as 'The arc of a great circle joining the North and South magnetic poles' as we can define the geographical meridian of the Earth that it is 'the arc of a Great circle joining the North and South Geographical poles of Earth'.

We therefore define the magnetic meridian as follows, "The magnetic meridian at any place is the direction that a

compass needle will take up when under the influence of the Earth's magnetic field only". (see A C Gardner –Navigation)

Finding the amount of variation

It is shown that the difference between the true direction and the magnetic direction is called the 'magnetic variation'. Now we discuss how we can find the amount of this variation at different locations on the surface of earth. There are several methods to find out this variation. One of those methods is the wellknown polestar system. you can find the pole star and by which the true North of the Earth. And you can compare your magnetic compass needle with the true North and find the difference very easily. The pole star could be found by looking the constellation "Ursamajor" as described before. Another method to determine the true North and South direction is the sun shadow circle method which is also mentioned above. Here I quote a complete illustration of this method as it is described by the famous scholar of "Ilmul Meekath" (The science of Islamic times and places) Al shaik Tahir jalaluddeen in his book 'Nukbathul Thakreerath' as follows .

Draw a sun shadow circle (Al –Dairathul Hindiyya) . Put your compass on the centre of that circle . Make the North South line of the circle and that line in the compass parallel in a vertical plane . If it is perfect you can understand that your compass is correct and the needle is showing the true North and South . If this does not occur you have to find the difference that is to say the variation. To attain this draw a circle on the crossing point of the North South line and East West line . The diameter of the circle should be equal to the diameter of the compass. And also draw a bigger circle which should be marked correctly from 0° to 360° . Put your compass again on the former one as the North South line of the compass apply on the North South line of the latter . Extend a thread parallel to the needle vertically and it would go on the latter circle passing upon the Northern and Southern part of the circle. Then take a compass and find the difference between the said mark and the North

point on the circumference of the circle . And that is the variation .

Geomagnetic field model

The systems we referred so far for finding out the magnetic declination from true North were in use from early times . At present there are modern mechanical systems for this purpose such as the one described by Dr. Manzur Ahmad (UK) in his Quibla calc . He writes : 'This (direction relative to magnetic north) is achieved using a sophisticated Geomagnetic field model to calculate the strength and direction of the Earth's magnetic field at any location'

Magnetic variation and Quibla point in Website

There is Website denoting the Quibla points and variations of all places on the surface of the Earth . Give your location; Latitude and Longitude in degree and minutes of arc . You can see in the computer screen the Quibla point of the location in degree, minutes and seconds of arc, you can also see a line extending from your location to Makkah . The variation will be minus (-) or plus (+) . The minus should be added to arc value shown in the screen and plus would be subtracted from that figure.

You can achieve the Quibla direction and magnetic declination (variation) from any location on Earth from Quibla calc Program and documentation by Dr Manzur Ahmad .

monz@starlight.dimon.co.uk

Here I write two examples for Quibla direction from true North and its variation from true North by which we can calculate Quibla direction from magnetic North . First example is for minus (-) variation and the second is for plus (+) variation.

(1)	location : Latitude	12°N
	Longitude	75° E
	Point of Quibla from true North	290.4°
	Variation	-1.99°
	Quibla point from magnetic North :	292.39°

(2) Location:	9°N lat
	70.4°E Long.
Quibla from true North :	70.4°
Variation:	1.12°
Quibla from magnetic North :	68.28°

Obtaining the Latitude and Longitude

It is obvious that Latitude and Longitude are essential for the discovery of Quibla point . How can we obtain these. You can find these in world atlases. But only prominent towns are mentioned in Atlases. We cannot obtain the local places in Atlases. It is a problem.

There are some methods described in books of 'Ilmul Meekath' (Science of Islamic time and place) by which we can easily find the Latitude and Longitudes of every places on Earth. Nowadays this is most easily achieved by the help of ' internet' you can see in Google wiki mapia..... every small towns and villages and all locations expressing Latitude and Longitude can obtain from it very easily. I quote here some examples caught from the Said wiki mapia .

- 1) India Kerala Kasaragod
Latitude : 12° 29' 32.95" N
Longitude: 74° 59' 28" E
- 2) India kerala Chattanchal
Latitude: 12° 28' 15" N
Longitude: 75° 3 '43" E
- 3) India Kanataka Vitla
Latitude: 12° 28 '15" N
Longitude: 75° 3' 43" E
- 4) India Karnataka Belthangadi
Latitude 12° 59 ' 15" N
Longitude 75°16' 58" E

Quibla compasses

At present times there are several kinds of north seeking instrumets called Quibla compasses or Ka-aba compass, which

is very useful to know the direction of Quibla in various Towns of the world .It is very helpful for travellers and pilgrims to perform prayers (swalath) during the travelling ocassions . The directions and discriptions shown in them are not such as the compasses we dealt with .

In these compasses the dial had divided in to 40 divisions or four hundred . One division will be 9 degree of arc or 0.9 degrees, that is to say 0°54' or 0°5'24" of arc. These instruments are accompanied with booklets showing Quibla points for several prominent towns .You can see that vast areas are included in one figur .wich will decrease the accuracy or make you Thrown in to big error. There fore you must be alert to check them and verify before using them for prayers or Quibla determination.